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Nonlinear NMR and magnon BEC in antiferromagnetic materials with coupled electron and nuclear spin precession

Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 2018 American Physical Society. We present a study of nonlinear NMR and Bose-Einstein condensation (BEC) of nuclear spin waves in antiferromagnetic MnCO3 with coupled electron and nuclear spins. In particular, we show that the observed behavior of NMR signals strongly contradicts the conventional description of paramagnetic ensembles of noninteracting spins based on the phenomenological Bloch equations. We present a theoretical description of the coupled electron-nuclear spin precession, which takes into account an indirect relaxation of nuclear spins via the electron subsystem. We show that the magnitude of the nuclear magnetization is conserved for arbitrary large excitation powers, which is drastically different from the conventional heating scenario derived from the Bloch equations. This provides strong evidence that the coherent precession of macroscopic nuclear magnetization observed experimentally can be identified with the BEC of nuclear spin waves with k=0.

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